

## APPENDIX B

### Marking Guidelines

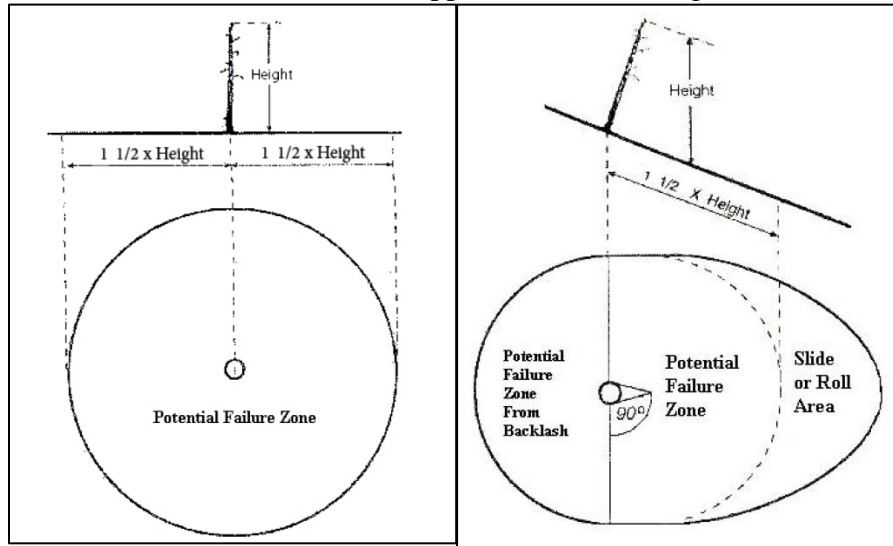
The Walker Fire was evaluated by USFS Region 5 Forest Health Protection (FHP) Entomologist Danny Cluck on November 7, 2019. The objective of this visit was to evaluate the levels of fire injury to conifers, note any insect activity and discuss variables that should be considered when developing fire-injured tree and hazard tree marking guidelines. Recommendations provided in this report assisted in the formulation of silvicultural prescriptions aimed at removing a portion of the fire-injured trees including the abatement of roadside hazard trees.

The guidelines developed by Region 5 FHP, *Marking guidelines for fire-injured trees in California* (Smith and Cluck 2011) were recommended for use to identify dead and dying trees in the Walker Fire area. Region 5 FHP hazard tree guidelines define failure and target potential and were provided for use to identify trees to be removed along roadsides (Angwin et al. 2012). Both guidelines can be used in combination along roadsides to identify whether fire injured tree will be considered dead and then identify their hazard level due to death, defect, form, decay, lean, etc. in order to mitigate trees that are likely to die from fire injuries and pose a hazard in the near future.

Dead and dying trees are identified and selected for removal using model-based metrics that predict Probability of mortality (Pm). Trees are evaluated by diameter and species on crown length scorched (for yellow pine), crown volume killed (for Douglas-Fir and lodgepole pine) and crown length killed (all other species to be evaluated in this project). The model calculates a Probability of mortality (Pm) per species based upon the above metrics. The Probability of mortality (Pm) levels incorporated into the guidelines are thresholds where all trees meeting or exceeding a selected Pm level are marked for removal.

Three silvicultural prescriptions written for the Walker Fire Recovery Project were reviewed by Danny Cluck on April 27, 2020 and found to be consistent with regional guidelines (Appendix B). These prescriptions are based on the fire injured tree marking guidelines (Report #RO-11-01, Smith and Cluck, May 2011) and/ or hazard tree marking guidelines (Report #RO-12-01, Angwin et al., April 2012) developed by Region 5 Forest Health Protection as well as Standard and Guidelines from the 2004 SNFPA. The guideline criteria for delayed conifer tree mortality are based on the post bud- break model or percent crown volume killed at probability of mortality level of 0.7 ( $P_m=0.7$ ). However to account for roadway safety, delayed mortality and deferred roadway maintenance, trees that are at least 1.5 times their height distance from system roads have a lower probability of mortality assessment level ( $P_m=0.5$ )<sup>1</sup> (Figure 1). One- and one-half tree height distance from the roadway is the currently recommended distance for hazard tree mitigation and represents the potential zone of impact for whole trees and tree parts after impact with other trees and the ground surface (Angwin et al. 2012, Filip et al. 2016). The premise here is that trees have and do roll, slide and have tremendous inertia and momentum before coming to rest. For this project, a general 200 foot distance from roads was used to recognize: (1) the area of potential ground disturbing effects, (2) extensive dead/ dying trees at or greater than 133 feet tall<sup>2</sup>, (3) slope distances from roads (i.e. influencing failure zone due to rolling/ movement of trees or tree parts), (4) harvest operation safety and (5) innate individual tree factors including lean, defect, brittleness of dead and dying timber (i.e. potential hazard trees or tree parts).

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**Figure 1.** Potential failure zone associated with total tree failure without slope or lean considerations (left figure) and with slope and lean considerations (right figure) from Angwin et al. 2012 and Filip et al. 2016.

For this project, a 0.7 Pm was selected for trees that would not strike a road or target. The 0.7 percent Pm was selected for the interior areas to prevent taking trees that may live, that may provide wildlife habitat, and natural regeneration. Also snag recruitment will likely occur with a conservative 70 percent Pm because some of the retained trees will likely die. Approximately 2,689 acres represent those areas where the 0.7 probability of mortality would apply and the 0.5 probability of mortality is located within 200 feet of Forest system roads and trails and covers 1,053 acres, for a treatment unit total of 3,742 acres.

Hazard trees that do not meet the 0.5 or 0.7 Pm (not fire killed or injured) but may strike a road or target are additionally evaluated using the Region 5 FHP hazard tree guidelines (Angwin et al. 2012). Defective trees with a high failure potential or high failure potential trees with multiple, interacting defects are also marked for removal if they may strike a road or target to remove the hazard to the roadway.

Additionally, trees are selected for removal that meet the following:

- Any tree with no green needles.
- For all species, trees should be marked for removal if any combination of boring dust or frass (in bark crevices, webbing along the bole, or that accumulates at the base of the trees), pitch tubes with pink or reddish boring dust associated with them, pouch fungus conks and/or current woodpecker activity (holes into the sapwood and/or bark flaking, specifically excludes injury caused by sapsucker feeding) is present over at least 1/3 of the bole circumference. This specifically excludes basal attacks by the red turpentine beetle on pines (large pitch tubes associated with coarse boring dust generally restricted to the lower 2 to 3 feet of the bole or woodpecker activity restricted to this area) and when the above indicators are only associated with wounds, old fire scars, etc.

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Table 1. Number of acres from the Walker Fire Recovery EA Project that are either >200ft or ≤200ft from a specific road.

	Acres	Percentage of treatment unit area	Employed probability of mortality (from Smith and Cluck 2011)
Portions of units ≤ 200ft distance from a road	1,053	28%	0.5
Portions of units > 200ft distance from a road	2,689	72%	0.7
Total	3,742	100%	

The objectives of these guidelines are to:

- 1) remove those trees that are dead or have a high probability of mortality due to fire-injury and live trees with structural defects that indicate high failure potential to abate potential hazards to visitors and improve safety and access within the Walker Fire area and
- 2) retain those trees that will likely survive to maintain visual quality, wildlife habitat and recreational values. This balance aims to retain healthy forest cover while providing for safety and access to the area.

**Note:** The marking guidelines do not include cambium sampling due to the additional time required to assess individual trees and the minimal loss of accuracy incurred by dropping this variable. In addition, the red turpentine beetle criteria will not be incorporated due to the limited amount of beetle activity at this time and the difficulty of using beetle criteria when trees are being evaluated from a distance.

*\*If operations extend past November 2020, the marking guidelines may be modified to incorporate criteria adjustments after the second winter season post-fire.*

Hazard Tree guidelines are for structurally defective trees with a high potential for failure (3 points) that are within striking distance of a road or facility (Striking distance = 1.5 x tree height and can be extended for steep uphill slopes).

**Note:** The following high failure potential (3 points) true fir will be retained since there is no evidence or history of a significant number of failures for these types of trees within the project area:

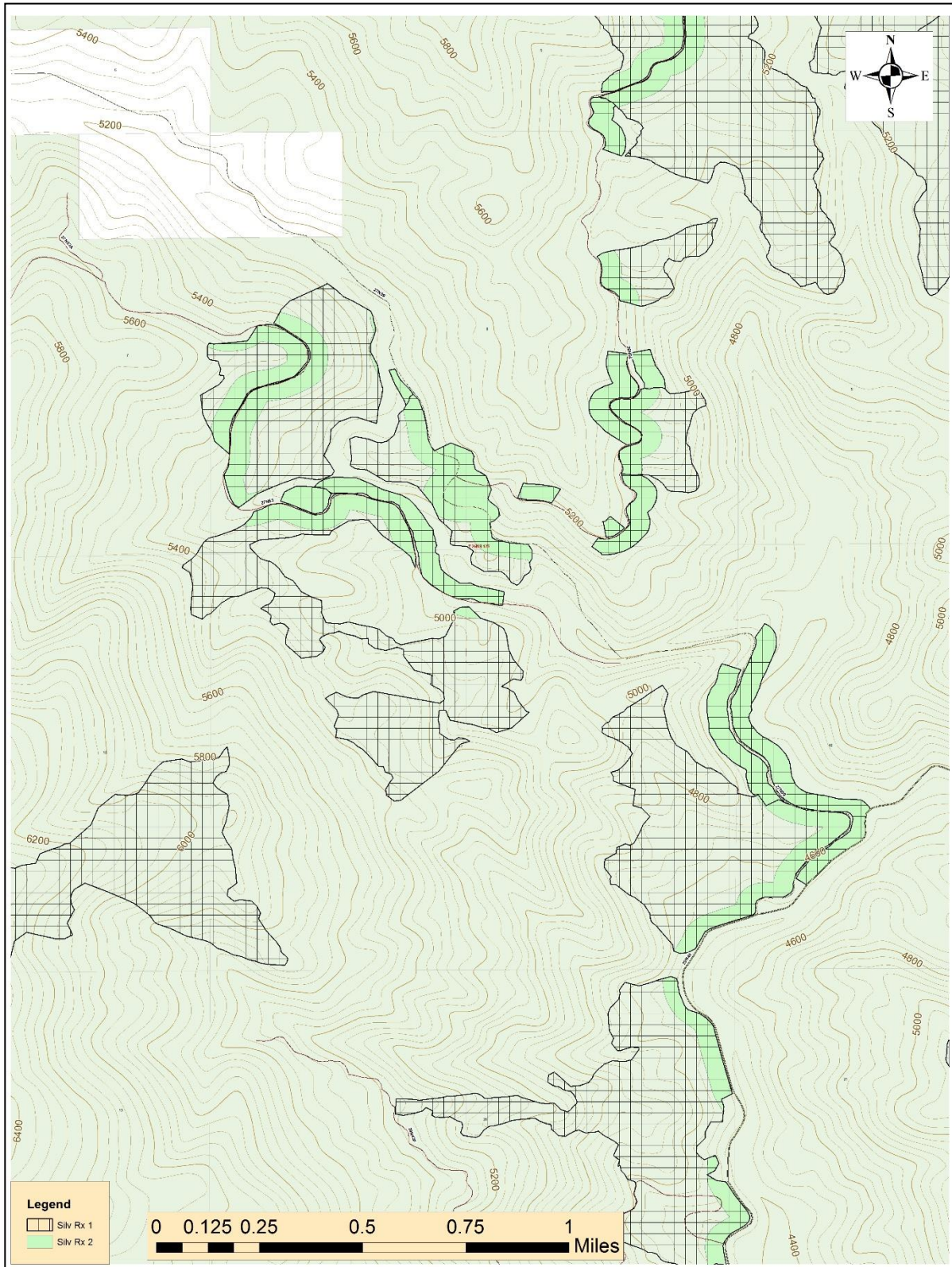
- A true fir with known, but unmeasured, decay that has > 50% healthy live crown ratio (no new or old branch dieback present).
- A true fir with up to four Indian paint fungus (*Echinodontium tinctorium*) conks that has > 50% healthy live crown ratio (no new or old branch dieback present).
- A true fir with a basal canker without decay over 1/3 of the bole circumference (but less than 1/2) but has > 50% healthy live crown ratio (no new or old branch dieback present).

These criteria assume that there are no other observable defects. One point should be added, and tree removed, if any other related defects are present (lean towards road prism, cracks in stem, root injury, etc.).



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**Figure 2. Silviculture Prescription Locations for Rx1 and Rx2**

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#### For All Prescriptions:

##### Select for removal any tree that meets the following criteria:

- 1) Any tree with no green needles.
- 2) For all species, trees should be marked for removal if any combination of boring dust or frass (in bark crevices, webbing along the bole, or that accumulates at the base of the trees), pitch tubes with pink or reddish boring dust associated with them, pouch fungus conks and/or current woodpecker activity (holes into the sapwood and/or bark flaking, specifically excludes injury caused by sapsucker feeding) is present over at least 1/3 of the bole circumference. This specifically excludes basal attacks by the red turpentine beetle on pines (large pitch tubes associated with coarse boring dust generally restricted to the lower 2 to 3 feet of the bole or woodpecker activity restricted to this area) and when the above indicators are only associated with wounds, old fire scars, etc.
- 3) Snag retention:
  - a) Retain four snags per acre in westside mixed conifer and ponderosa pine types;
  - b) Retain three snags per acre in eastside pine and eastside mixed conifer forest types
  - c) Use snags larger than 15 inches DBH and 20' in height to meet this guideline. Snags should be clumped and distributed irregularly across the treatment units.
  - d) At least two of these per acre should be “soft” pre-existing snags. Retain all smaller diameter snags within clump.
  - e) Snags retained outside of unit boundaries, and within exclusions in the unit may count toward these clumps. Maintain these clumps during site prep and/or biomass removal.

##### Additionally, add specifications below depending upon location:

- Rx1- General Interior Salvage
- Rx2- Hazard tree removal within 1.5 times tree height (200ft) of FS roads
- Rx3- Fire Monitoring Research

#### **Rx1- General Interior Salvage (Pm 0.7)**

Select for removal any tree that meets or exceeds the fire-injured conifer mortality guidelines (Table 2) at the **Pm = 0.7 level**.

This assessment will be made by visually estimating the percent of the original pre-fire crown length or volume that was killed and tree diameter (as determined by species) (Figure 4, Figure 5).

#### **Rx2- Hazard tree removal within 200 feet of system roads (Pm 0.5 or Hazard Tree Guidelines):**

If the tree is within 1.5 tree height distance (200 feet) of a system road and within striking distance of a road or target mark for removal:

Any tree that meets or exceeds the fire-injured conifer mortality guidelines (Table 2) at the **Pm = 0.5 level**.

This assessment will be made by visually estimating the percent of the original pre-fire crown length or volume that was killed and tree diameter (as determined by species) (Figure 4, Figure 5).

#### **OR**

All moderate and high hazard potential trees (Angwin et al. 2012, pages 18- 20, Table 6).

(If the tree is within 200' of FS roads but not within 1.5 tree height striking distance, use Rx1.)

#### **Rx3- Fire Monitoring Research**

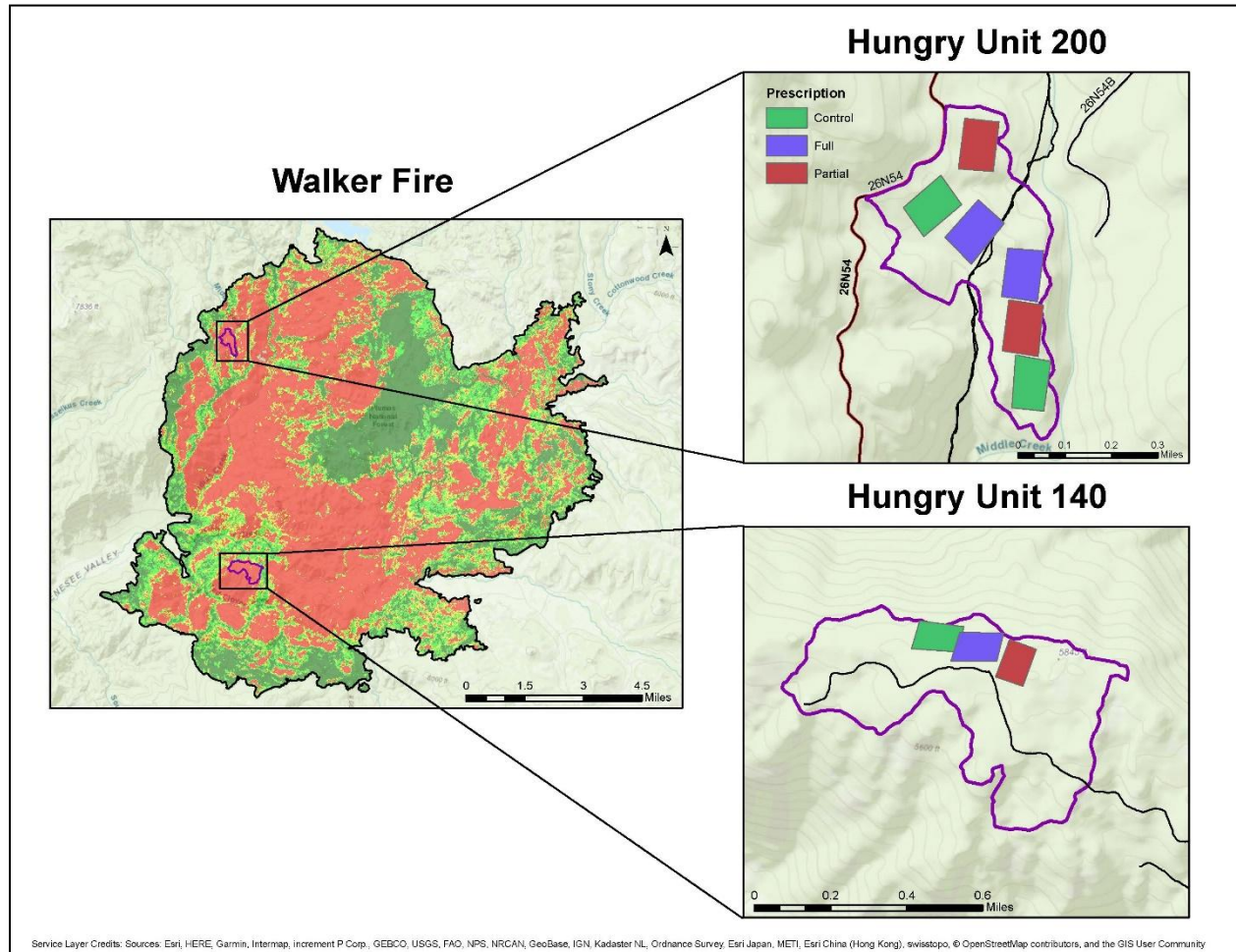


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Research and Monitoring is planned to occur within one of the Walker Fire Recovery Project treatment units (Figure 3). The purpose for the research is *Quantifying the Effects of Variable Density Retention Salvage Logging on Forest Structure, Fuel Succession and Wildfire Behavior*.

- Follow prescription for Rx1 or Rx2 as determined by location.
- Research will included control plots where no treatment will occur, plots that are leave-tree marked to retain all trees in subplots, and plots where the cut is Rx1 or Rx2 (determined by location).



**Figure 3. Location and treatment types of the research and monitoring plots within two Walker Fire Recovery EA units.**

## **Post-bud break marking guidelines**

*Table 2. Crown condition assessment protocols from Smith and Cluck 2011*

Yellow Pine	.5Pm	.7Pm
DBH	Minimum % Crown Length Killed	Minimum % Crown Length Killed
12.0-<30"	50	60
30-40"	25	40
>40"	10	25
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sugar Pine	<input type="checkbox"/>	<input type="checkbox"/>
DBH	Minimum % Crown Length Killed	Minimum % Crown Length Killed
>/=12.0"	50	60
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
White Fir	<input type="checkbox"/>	<input type="checkbox"/>
DBH	Minimum % Crown Length Killed	Minimum % Crown Length Killed
12.0-35"	75	80
>35"	60	70
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Red Fir	<input type="checkbox"/>	<input type="checkbox"/>
DBH	Minimum % Crown Length Killed	Minimum % Crown Length Killed
>/=12.0"	70	80
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Incense Cedar	<input type="checkbox"/>	<input type="checkbox"/>
DBH	Minimum % Crown Length Killed	Minimum % Crown Length Killed
>/=12.0"	85	90
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Douglas-Fir	<input type="checkbox"/>	<input type="checkbox"/>
DBH	Minimum % Crown Volume Killed	Minimum % Crown Volume Killed
>/=12.0	65	75
Lodgepole Pine		
DBH	Minimum % Crown Volume Killed	Minimum % Crown Volume Killed
>/=12.0-15.0"	20	45
>15.0"	35	50

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<p><b><u>Failure Potential (Defect)</u></b> 3 points = high potential for failure: serious defects. <u>Add 1 point</u> if multiple, interacting defects are present, e.g. leaning tree with other defects. Score 4 points (the maximum score) if tree is dead.</p> <p><b><u>Cracks</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Crack goes completely through stem or branch.</li> <li>• Stem has two cracks on the same segment with a cavity or extensive decay.</li> <li>• Crack in contact with another defect or is at the base of a leaning tree.</li> <li>• Branch (4" or larger) with any crack.</li> <li>• Conifer stem with a single crack with inrolled bark and a cavity or decay inside.</li> </ul> <p><b><u>Branch Unions/Forked Tops</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Weak branch union (V-shaped with inrolled bark) that is also cracked, cankered, decayed or streaming pitch. Strong (U-shaped) branch unions with these defects, except as listed below, should be assessed on the basis of the associated defects.</li> <li>• Heavy U-shaped branches of all species except for pines and incense cedar that form when branches turn up to become leaders. Pine and incense cedar receive a high rating only if an associated defect (cracked, cankered, decayed or streaming pitch) is also present at the branch union.</li> <li>• Large epicormic branches on decaying stems and branches.</li> </ul> <p><b><u>Stem or Branch Decay</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Less than 1/3 of the tree's radius (or diameter) is sound. Additional sound wood needed if tree is leaning, decay is off-center or present between four feet above the groundline and the lowest live branch, or is associated with an open cavity.</li> <li>• Cavity, decay or fruiting body associated with an open crack or weak branch union.</li> <li>• Decay in a horizontal branch.</li> <li>• True fir and hardwoods with known, but unmeasured decay, especially if a cavity is open to the outside.</li> </ul> <p><b><u>Fungal Fruiting Bodies</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• <i>Phaeolus schweinitzii</i> conks associated with butt swell on Douglas-fir.</li> <li>• One or more Indian paint fungus (<i>Echinodontium tinctorium</i>) conks on true fir or hemlock</li> <li>• Five or more red ring rot (<i>Porodaedalia</i> (<i>Phellinus</i>) <i>pini</i>) conks on Douglas-fir, ponderosa pine, Jeffrey pine, lodgepole pine, or more than one on true fir or hemlock.</li> <li>• One or more quinine (<i>Fomitopsis officinalis</i>) conks on Douglas-fir, pines, western larch, spruce or hemlock.</li> <li>• One or more sulfur fungus (<i>Laetiporus sulphureus</i>)</li> </ul>	<p><b><u>Cankers</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Cankers with associated fruiting bodies of decay fungi.</li> <li>• Cankers with associated internal decay.</li> <li>• Canker physically connected to a crack or other defect.</li> <li>• Single or multiple cankers without decay over more than 1/2 of the tree's circumference, particularly if the cankers are between four feet above the groundline and the lowest live branch.</li> <li>• Basal cankers in true fir that affect over 1/3 of the bole circumference.</li> <li>• Deep charring in true fir over more than 1/3 of the bole circumference when the relationship between deep char and cambial mortality has been confirmed.</li> <li>• Deep charring in sugar pine, ponderosa pine, Jeffrey pine, incense cedar or Douglas-fir over 1/2 of the bole circumference when the relationship between deep char and cambial mortality has been confirmed.</li> </ul> <p><b><u>Dead Tree, Top Or Branches</u></b> <b>Extremely High (4 points):</b></p> <ul style="list-style-type: none"> <li>• Dead tree.</li> </ul> <p><b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Dead top greater than ten feet long or smaller ones with associated decay or other defect (note that old dead tops of pine, incense cedar, juniper or Douglas-fir may not have high failure potential).</li> <li>• Dead branches greater than two inches in diameter, branches that are hanging or lodged in the crown, large dead dwarf mistletoe brooms and large live dwarf mistletoe brooms with associated decay or defect.</li> </ul> <p><b><u>Bark and/or Wood Boring Beetle-Attacked Trees</u></b> <b>High (3 points) If any of the following over at least 1/3<sup>rd</sup> of the bole circumference (excluding basal attack by red turpentine beetle):</b></p> <ul style="list-style-type: none"> <li>• Pitch tubes with pink or reddish (not clear) boring dust.</li> <li>• Pouch fungus conks and/or current woodpecker (not sapsucker) activity.</li> <li>• Boring dust or frass in bark crevices, webbing along the bole, or accumulation of boring dust or frass at the base of the tree.</li> <li>• 50% or more of the foliage-bearing crown actively fading, as indicated by a uniform change in color over that part of the crown. Dead tops that have no foliage do not count toward this 50%. Also does not include drought-induced needle cast (non-uniform fading restricted to the older needles) or branch mortality ("flagging") caused by dwarf mistletoe/<i>Cytospora</i> infections in true fir.</li> </ul> <p><b><u>Root Damage and Root Disease</u></b> <b>High (3 points):</b></p> <ul style="list-style-type: none"> <li>• Recently leaning trees, or with recent root-lifting, soil movement or mounding near the base, or with broken/decayed roots.</li> <li>• Inadequate root support, with more than half of the root system within the drip line severed, broken, undermined or decayed by erosion or excavation.</li> <li>• Host tree species visibly infected with root disease fungi, adjacent to visibly infected trees or stumps, or with advanced crown symptoms in the immediate area where Heterobasidion root</li> </ul>
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conks on a wide range of conifers and hardwoods, including Douglas-fir, true firs, pines, hemlocks, spruces, larch, western redcedar, oaks, maples, birch and willow.

disease has been identified.

### **Leans and Poor Tree Architecture**

#### **High (3 points):**

- Leaning with an angle greater than 45° from vertical.
- Leaning with other contributing defects.
- Freshly leaning tree with recent root lifting, soil movement or mounding near the base.
- Lean associated with unstable soils or cracks in the tree.
- Uncorrected lean compounded by unbalanced crown shape weighted in the direction of the lean.
- Uncorrected lean at a location with frequent storm or wind injury.

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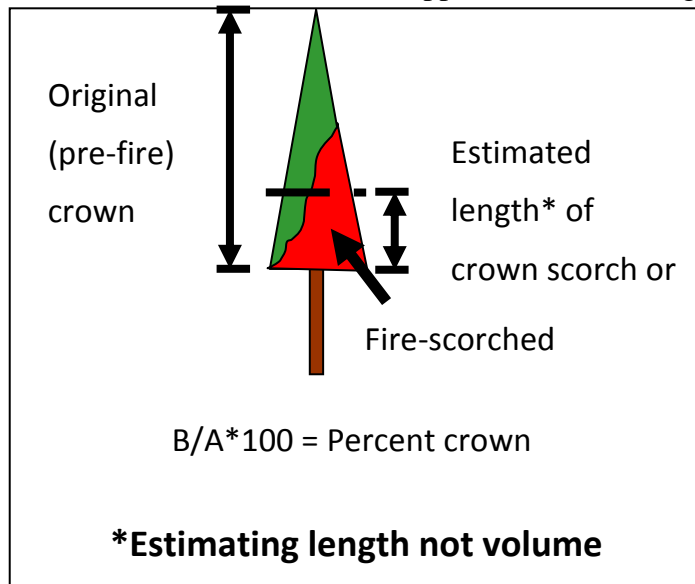


Figure 4. Evaluation of Percent Crown Length Scorched or Killed

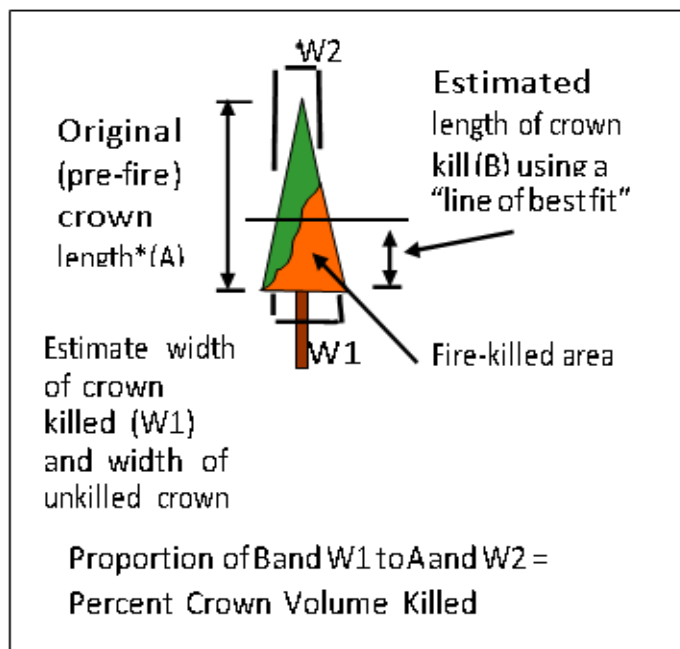


Figure 5. Evaluation of crown volume killed for Douglas Fir and Lodgepole Pine